UNIVERSITEIT GENT

Department of Food Safety and Food Quality

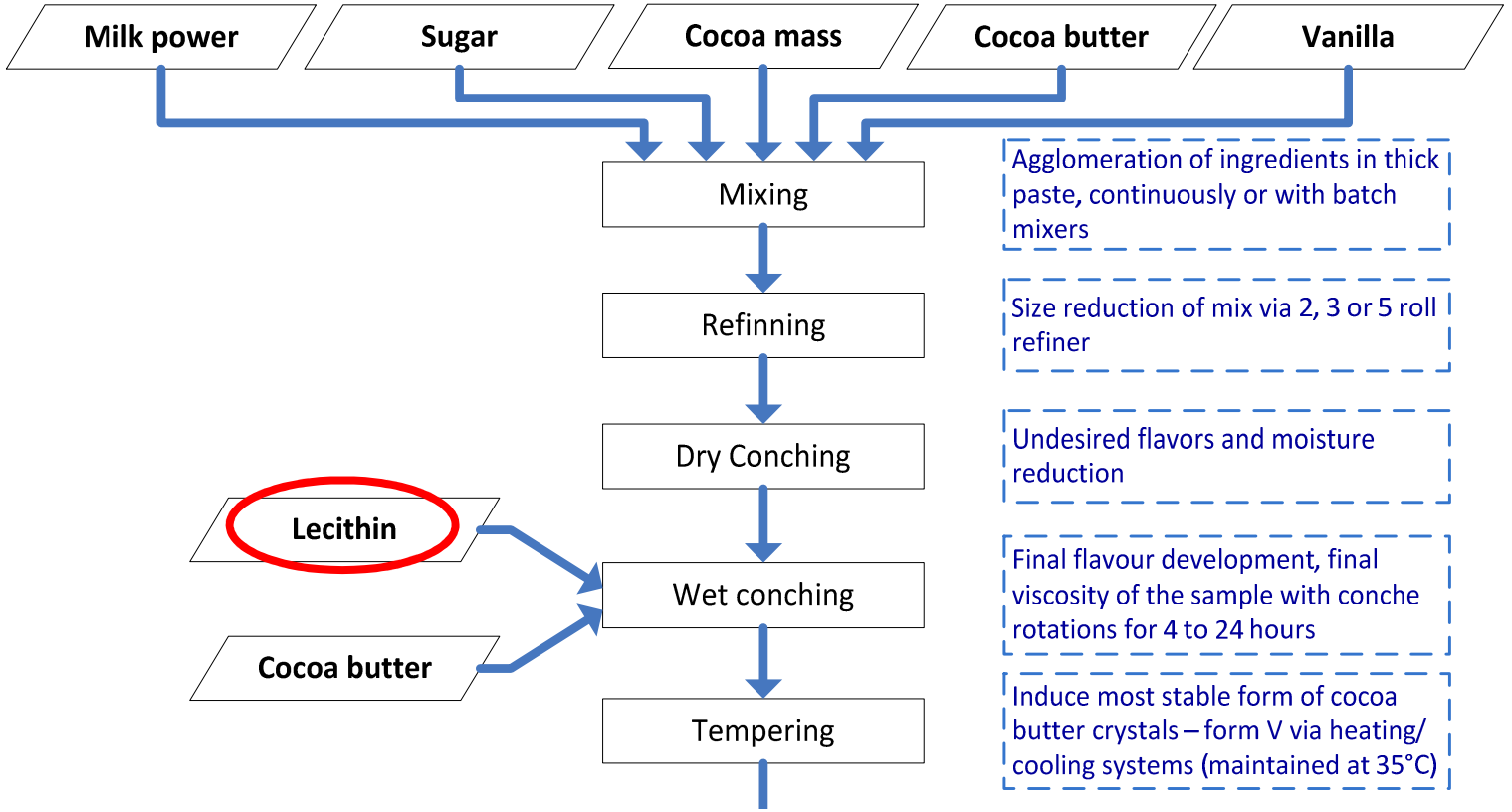
Potential of milk polar lipids in chocolate products: Sensory and instrumental evaluation

Mai Tuyet Nguyen, Sara De Pelsmaeker, Joachim J. Schouteten, Xavier Gellynck, Koen Dewettinck

VBFOODNET conference
Ha Noi, 11-13th Nov 2013

Faculteit Bio-ingenieurswetenschappen
Faculty of Bioscience Engineering

Chocolate production

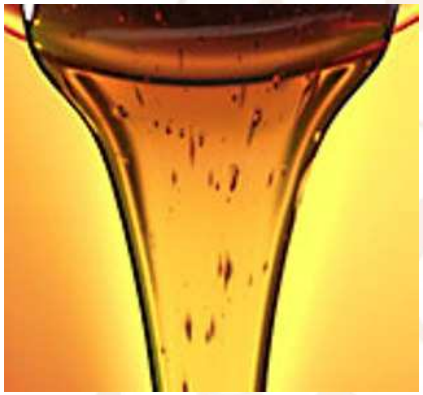


Ingredient	Dark chocolate (%)	Milk chocolate (%)
Pre-ground sugar	48	40
Cocoa mass (54.4% fat)	40	16
Cocoa butter	11.6	18.6
Skimmed milk powder (1% fat)	0	5
Whole milk powder (26.2% fat)	0	20
Soy lecithin	0.4	0.4

Vegetable lecithin

Lecithin is defined as a mixture of polar and neutral lipids with a polar lipid content (insoluble in acetone) of at least 60%:

- Polar lipids: phospholipids and glycolipids → active components
- Neutral lipids: triglycerides and free fatty acids
- Minor components: carbohydrates, (glyco)sterols, fibre, minerals, ...



Soy lecithin

- Soy allergies: Histamine intolerance
- GMO: Until July 2013, 93% of all soybeans planted in the United States was genetically modified (USDA, 2013)

Soy-free chocolate?

Preparation of milk polar lipids

- Beneficial-health effects
- Milk polar lipids concentrate (MPC) - Lacprodan® PL20

PL composition (%)	MPC	Soy lecithin
PC	27.9	27.1
PI	7.4	22.5
PE	18.5	21.7
PA	n.d	15.5
PS	15.8	n.d
SM	22.5	n.d
Others	7.9	13.2
Total PLs	**23.1**	**47.8**

Chocolate recipes with MPC

Ingredient	Dark chocolate (%)	Milk chocolate (%)
Sugar	47.6	39.7
Cocoa mass	39.7	15.9
Cocoa butter	11,9	18.9
Skimmed milk powder	0	5
Whole milk powder	0	19.8
MPC	0.82	0.82

Analyses

Emulsifier:

1) Soy lecithin for reference chocolates
2) MPC (Lacprodan® PL20) for MPC chocolates

Instrumental analysis

- Rheological measurements: viscosity and yield stress

- Texture analysis: hardness

- DSC: melting temperature

- Colour

Sensory analysis

Trained panel (9 members)

Consumer panel (152 participants)

Discriminative tests

Triangle test

Two directional-paired comparison tests
- Fat content
- Degree of hardness

Descriptive tests

Quantitative descriptive analysis

- Colour (light/dark brown)
- Gloss (mat/glossy)
- Fat bloom (absent/present)
- Cocoa smell (light/intense)
- Sweet smell (light/intense)
- Snap (absent/present)
- Hardness (soft/hard)
- Melting behaviour (slow/fast)
- Graininess (smooth/grainy)
- Sweet taste (weak/intense)
- Bitter taste (weak/intense)
- Milk flavour (weak/intense)
- Nut flavour (weak/intense)
- Flavour intensity (weak/intense)

Affective tests

Preference test

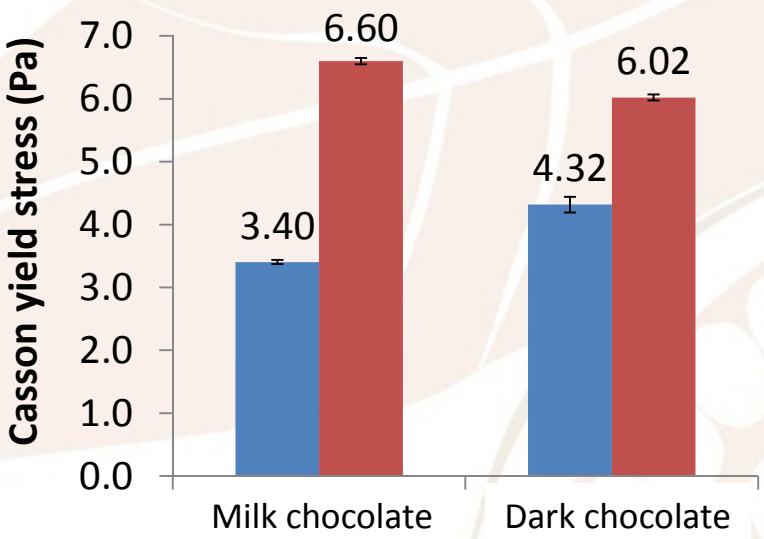
Evaluating attributes on JAR-scale

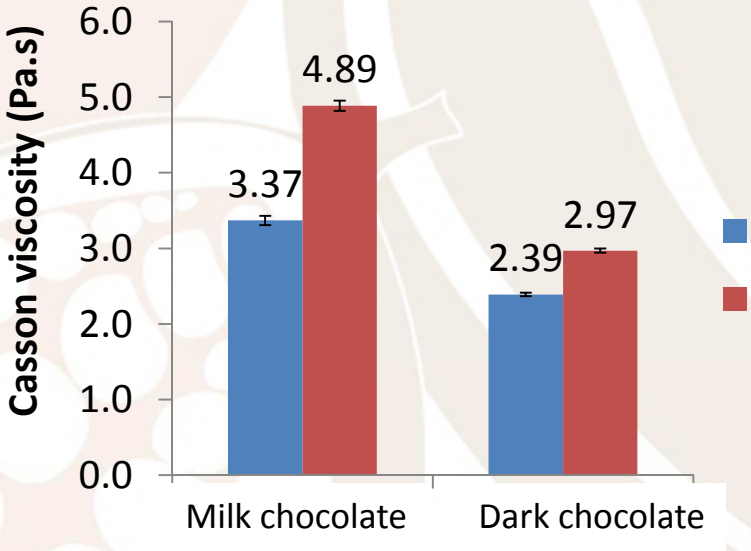
Acceptance test

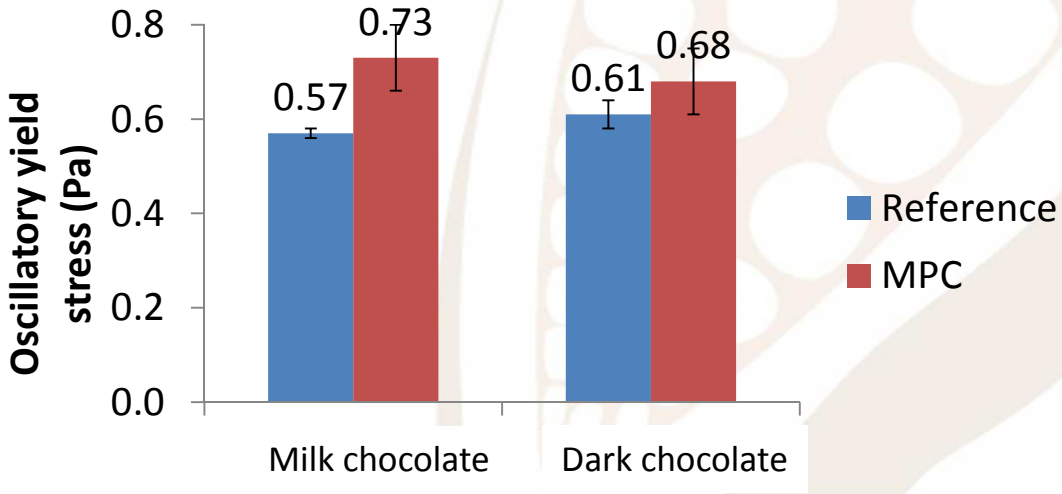
Repeat preference test

Results

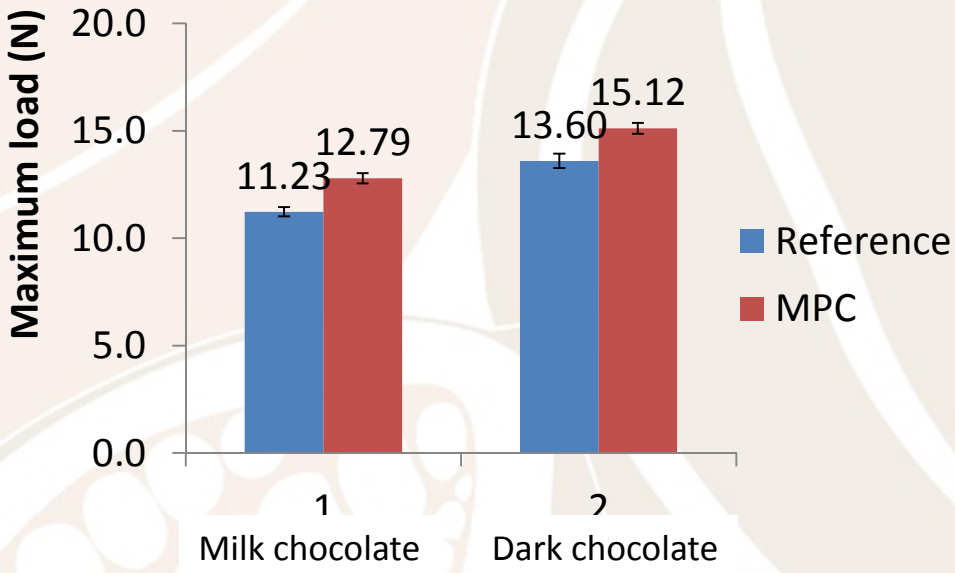
Rheological measurement



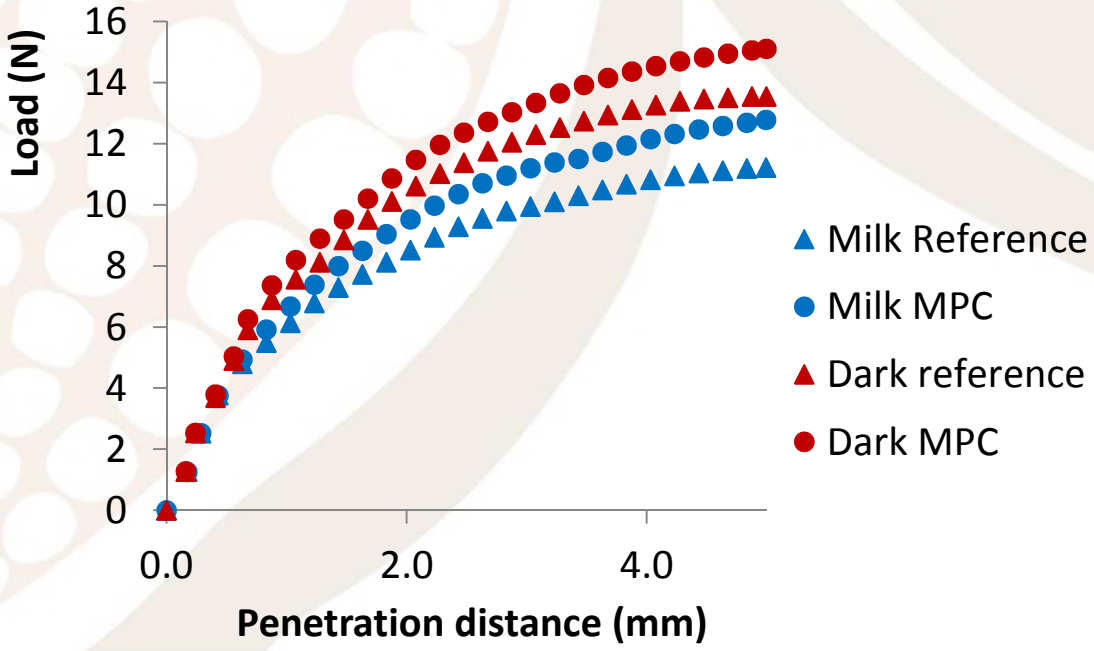




Maximumn load (N)



Load v.s penetration distance



Melting temperature (DSC)

	Melting Temperature (°C)
Milk reference	**33,7 ± 0,3**
Milk MPC	**33,6 ± 0,03**
Dark reference	**34,1 ± 0,1**
Dark MPC	**34,03 ± 0,6**

Color measurement

	Milk chocolate		p-value	Dark chocolate		p-value
	Reference	MPC		Reference	MPC	
L-value	36,47 ± 0,28	35,67 ± 0,28	< 0,001*	27,26 ± 0,67	26,66 ± 0,73	0,09
a-value	9,49 ± 0, 31	9,94 ± 0,12	0,002*	6,06 ± 0,25	6,09 ± 0,45	0,87
b-value	10,10 ± 0,54	10,53 ± 0,23	0,04*	3,79 ± 0,41	3,11± 0,31	0,11

Sensory analysis

Trained panel (9 members)

Discriminative tests

Descriptive tests

Sensory analysis

Trained panel (9 members)

Discriminative tests

- Triangle test → 6/9 – significant difference at 5% level ✗

Two directional-paired comparison tests

- Fat content → 8/9 – significant difference at 5% level ✗
- Degree of hardness → Milk chocolate: Milk ref harder than Milk MPC ■
  Dark chocolate: Not significant difference ✗

Descriptive tests

Sensory analysis

Trained panel (9 members)

Discriminative tests

Triangle test → 6/9 – significant difference at 5% level ✗

Two directional-paired comparison tests

- Fat content → 8/9 – significant difference at 5% level ✗
- Degree of hardness → Milk chocolate: Milk ref harder than Milk MPC; Dark chocolate: Not significant difference ■ ✗

Descriptive tests

Quantitative descriptive analysis (QDA)

Sensory analysis

Quantitative descriptive analysis results of milk and dark chocolate

	Milk chocolate			Dark chocolate		
Attribute	Reference (mean± SD)	MPC (mean± SD)	p-value	Reference (mean± SD)	MPC (mean± SD)	p-value
Colour	1,39 ± 0,75	1,49 ± 0,57	0,66	2,39 ± 0,36	2,58 ± 0,31	0,10
Gloss	1,11 ± 0,89	1,36 ± 1,05	0,29	1,58 ± 0,98	1,36 ± 1,00	0,08
Fat Bloom	1,20 ± 1,18	1,30 ± 1,22	0,38	1,36 ± 1,06	1,48 ± 1,06	0,44
Cocoa Smell	0,89 ± 0,98	1,14 ± 0,97	0,15	2,05 ± 0,76	1,71 ± 0,70	0,16
Sweet Smell	1,18 ± 0,78	1,31 ± 0,87	0,13	1,18 ± 0,67	1,31 ± 0,71	0,16
Snap	2,05 ± 0,95	2,34 ± 0,50	0,18	0,98 ± 0,95	1,10 ± 0,79	0,77
Hardness	1,66 ± 0,90	1,99 ± 0,71	0,77	1,96 ± 0,42	1,42 ± 0,68	0,82
Sweet Taste	2,16 ± 0,35	2,38 ± 0,36	0,14	1,49 ± 0,68	1,71 ± 0,89	0,17
Bitter Taste	0,58 ± 0,65	0,55 ± 0,49	0,78	2,03 ± 0,62	2,12 ± 0,53	0,72
Milk Flavour	2,23 ± 0,32	2,06 ± 0,55	0,52	0,30 ± 0,48	0,23 ± 0,31	0,71
Nut Flavour	0,85 ± 0,80	0,98 ± 1,15	0,53	0,50 ± 0,67	0,54 ± 0,50	0,90
Flavour Intensity	2,09 ± 0,32	2,48 ± 0,26	0,05*	1,96 ± 0,87	2,26 ± 0,82	0,36
Melting Behaviour	2,01 ± 0,52	1,89 ± 0,43	0,48	1,35 ± 0,78	0,97 ± 0,58	0,15
Graininess	0,86 ± 0,83	1,04 ± 1,04	0,30	0,91 ± 0,87	1,17 ± 1,08	0,31

Sensory analysis

Quantitative descriptive analysis results of milk and dark chocolate

	Milk chocolate			Dark chocolate		
Attribute	Reference (mean± SD)	MPC (mean± SD)	**p-value**	Reference (mean± SD)	MPC (mean± SD)	**p-value**
Colour	1,39 ± 0,75	1,49 ± 0,57	**0,66**	2,39 ± 0,36	2,58 ± 0,31	**0,10**
Gloss	1,11 ± 0,89	1,36 ± 1,05	**0,29**	1,58 ± 0,98	1,36 ± 1,00	**0,08**
Fat Bloom	1,20 ± 1,18	1,30 ± 1,22	**0,38**	1,36 ± 1,06	1,48 ± 1,06	**0,44**
Cocoa Smell	0,89 ± 0,98	1,14 ± 0,97	**0,15**	2,05 ± 0,76	1,71 ± 0,70	**0,16**
Sweet Smell	1,18 ± 0,78	1,31 ± 0,87	**0,13**	1,18 ± 0,67	1,31 ± 0,71	**0,16**
Snap	2,05 ± 0,95	2,34 ± 0,50	**0,18**	0,98 ± 0,95	1,10 ± 0,79	**0,77**
Hardness	1,66 ± 0,90	1,99 ± 0,71	**0,77**	1,96 ± 0,42	1,42 ± 0,68	**0,82**
Sweet Taste	2,16 ± 0,35	2,38 ± 0,36	**0,14**	1,49 ± 0,68	1,71 ± 0,89	**0,17**
Bitter Taste	0,58 ± 0,65	0,55 ± 0,49	**0,78**	2,03 ± 0,62	2,12 ± 0,53	**0,72**
Milk Flavour	2,23 ± 0,32	2,06 ± 0,55	**0,52**	0,30 ± 0,48	0,23 ± 0,31	**0,71**
Nut Flavour	0,85 ± 0,80	0,98 ± 1,15	**0,53**	0,50 ± 0,67	0,54 ± 0,50	**0,90**
Flavour Intensity	**2,09 ± 0,32**	**2,48 ± 0,26**	**0,05***	1,96 ± 0,87	2,26 ± 0,82	**0,36**
Melting Behaviour	2,01 ± 0,52	1,89 ± 0,43	**0,48**	1,35 ± 0,78	0,97 ± 0,58	**0,15**
Graininess	0,86 ± 0,83	1,04 ± 1,04	**0,30**	0,91 ± 0,87	1,17 ± 1,08	**0,31**

Sensory analysis

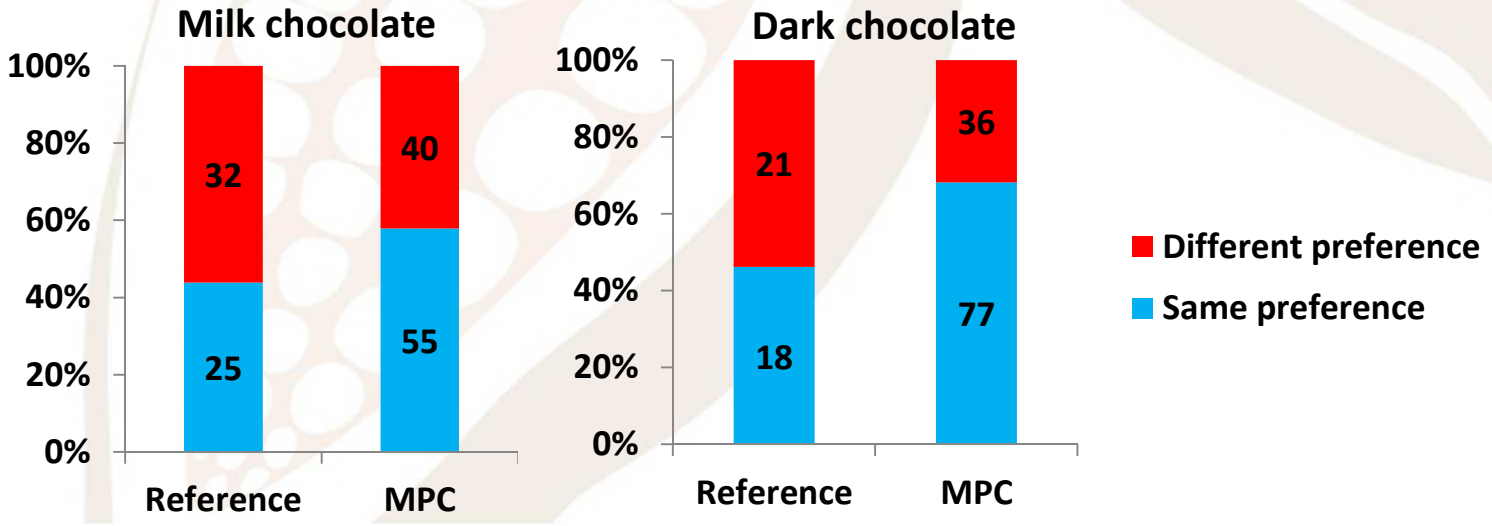
Consumer analysis (152 participants) → **Preference test**

First and second preference

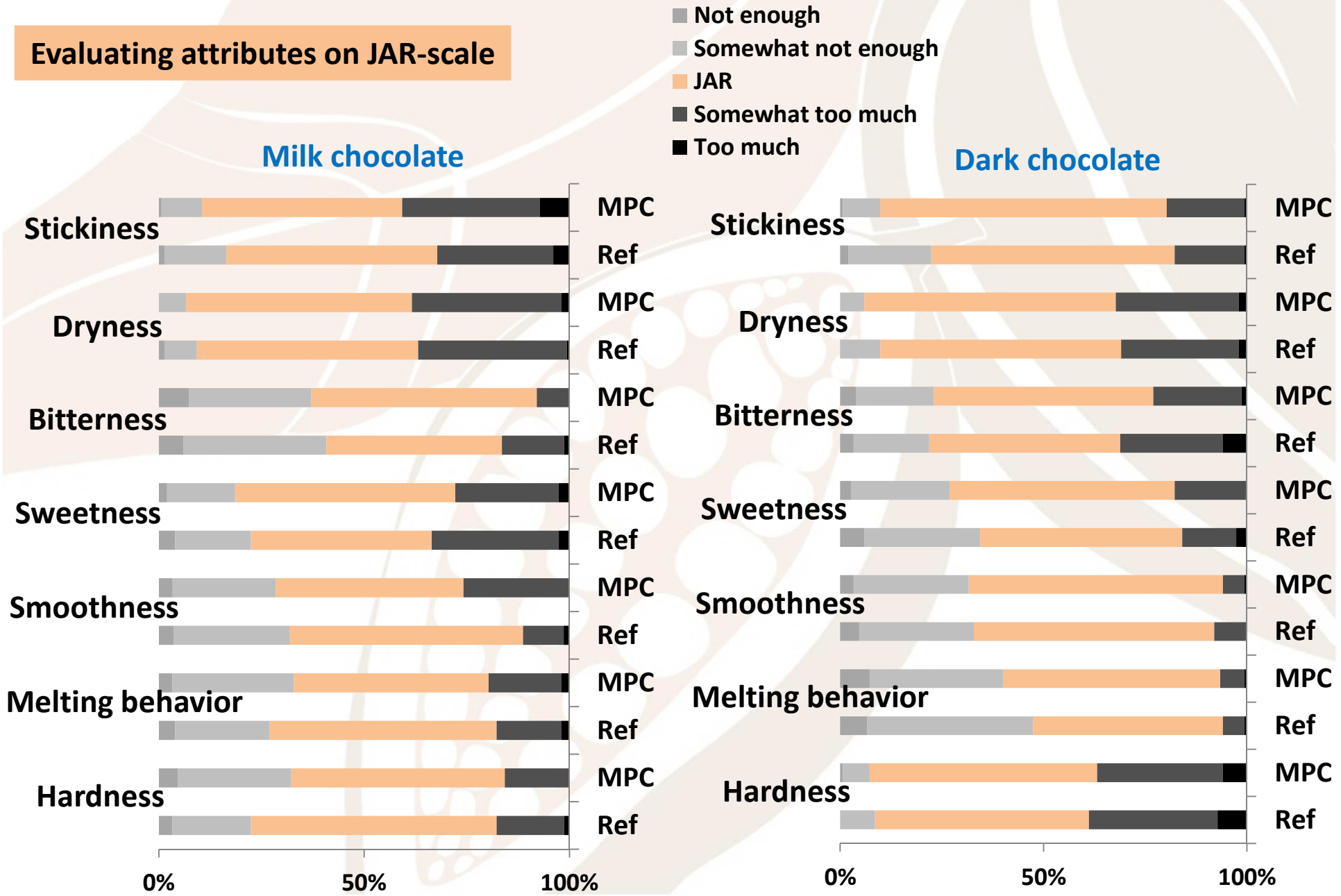
	Milk chocolate				Dark chocolate			
	First preference		Second preference		First preference		Second preference	
	Reference	MPC	Reference	MPC	Reference	MPC	Reference	MPC
Overall	**57^{a}**	**95^{b}**	**63**	**89**	**39^{a}**	**113^{b}**	**54^{a}**	**98^{b}**
Men	32	47	31	48	25^{a}	54^{b}	29^{a}	50^{b}
Women	25^{a}	48^{b}	32	41	14^{a}	59^{b}	25^{a}	48^{b}

a,b Row means within each taste session with different letters are significantly different ($p \leq 0.05$)

Preference consistency



Evaluating attributes on JAR-scale



Sensory analysis

General acceptance evaluations of the four chocolate samples on 9-hedonic scale

	Reference (mean± SD)	MPC (mean± SD)	p-value
Milk sample	6,02 ±1,35	6,36 ±1,36	0,01*
Dark sample	6,06 ±1,61	6,62 ±1,44	0,00*

**Samples are significantly different when p ≤ 0,05*

Conclusion

- Milk polar lipids – milk lecithin: emulsifing properties, both o/w and w/o type
- Milk polar lipids concentration – Lacprodan PL20: although there is some technological issue that still need to solvent, it is proved that milk polar lipids concentrate is a potential ingredient to replace soy lecithin to produce soy-free high quality chocolate
- High value-added chocolate

Thank you for your attention